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Drones for Smart Agriculture: A Technical Report

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Abstract: ***One of main source of income in of India is Agriculture. The production rate of crops in agriculture is based on various parameters like temperature, humidity, rain, etc. Which are natural factors and not in farmers control. The field of agriculture is also depends on some of factors like pests, disease, fertilizers, etc which can be control by giving proper treatment to crops. Pesticides may increase the productivity of crops but it also affects on human health. So the main aim of this paper is to design agriculture drone for spraying pesticides. In this paper, we are going to discus different architecture based on unmanned aerial vehicles (UAVs). The use of pesticides in agriculture is very important to agriculture and it will be so easy if will use intelligent machines such as robots using new technologies. This paper gives the idea about various technologies used to reduce human efforts in various operations of agriculture like detection of presence of pests, spraying of UREA, spraying of fertilizers, etc. This paper describes the development of quad copter UAV and the spraying mechanism. In this paper we also discuss integration of sprayer module to quad copter system. The discussed system involves designing a prototype which uses simple cost effective equipment like BLDC motor, Arduino, ESC wires, etc.***

Keywords: Unmanned Arial vehicles, Brushless motors, remote sensing, ESC wires, Li Pro wireless charger.

I. INTRODUCTION

Agriculture in India constitutes more than 60% of occupation. It serves to be the backbone of Indian economy. It is very essential to improve the productivity and efficiency of agriculture by providing safe cultivation of the farmer. The various operations like spraying of pesticides and sprinkling fertilizer are very important. Though spraying of pesticides has become mandatory it also proves to be a harmful procedure for the farmers. Farmers especially when they spray urea, take to many precautions like wearing appropriate outfit masks and gloves. It will avoid any harmful effect on the farmers. Avoiding the pesticides is also not completely possible as the required result has to be met. Hence fore, use of robots in such cases gives the best of the solutions for this type of problems, along with the required productivity and efficiency of the product [1]. According to survey conducted by WHO (world health organization) it is estimated that every year about 3 million workers are affected by poisoning from pesticides from which 18000 die. This projects aims to overcome the ill-effect of the pesticides on human beings and also use to spray pesticides over large area in short intervals of time compare to conventional spraying by using automatic fertilizer sprayer. This device is basically combination of spraying mechanism on a quad copter frame [3].This model is used to spray the pesticides content to the areas that cannot easily accessible by humans. The universal sprayer system use to spray liquid as well as solid contents which are done by the universal nozzle [26].

II. LITERATURE SURVEY

Prof. P. P. Mone, Chavhan Priyanka Shivaji, Jagtap Komal Tanaji, Nimbalkar Aishwarya Satish has published a paper entitled “Agriculture Drone for Spraying fertilizer and Pesticides”. In this paper authors has given detail about implementation of Agriculture drone for automatic spraying mechanism. In this paper, they gave problem statement of World Health Organization where it estimates that there are 3 million cases of pesticide poisions in each year and upto 220,000 deaths, primarily in developing countries. In this paper they also explain what precautions the farmer should have to use to avoid harmful effects of pesticides and fertilizing effects as well as cost effective technology using components such as PIC microcontroller for the control of agriculture robots. The published paper is available at IJRTI, Volume 2, Issue 6, 2017.[1]

Prof. S. Meivel M.E., Dr. R. Maguteeswaran Ph.D., N. Gandhiraj B.E., G. Srinivasan Ph.D. has published a paper entitled “Quadcopter UAV based Fertilizer and Pesticide Spraying System”. In this paper authors has given detail about implementation of Agriculture wonder drone. They gave detail about Quadcopter UAV and sprayer module and also discuss pesticide content to the areas that can’t easily accessible for human beings. They discussed used of multispectral cameras which is used to capture remote sensing images to identify the green field as well as the edges of crop area. Total pay load lift of their quad copter is 8 kg. They used QGIS software for the purposed of analyzing the remote sensing images. The published paper is available at International Academic Research, Journal of Engineering Sciences, Volume 1, Issue 1, February 2016.[26]

Prof. K. B. Korlahalli, Mr. Mazhar Ahmed Hangal, Mr. Nitin Jituri, Mr. Prakash Frances Rego, Mr. sachin M. Raykar published a paper entitled "An Automatically Controlled Drone based Aerial Pesticide Sprayer". In this paper authors has given detail about implementation of Agriculture Wonder Drone System. In this paper, the wireless drone system based on flight controlled board (FCB), GPS, Brushless DC motor, electronic speed control (ESC), wireless transceiver, frame, propellers and battery, etc. They used flight controller board for controlling the function of drone such as movement, lifting, positioning, etc. FCB is programmed in this project for handling different sensors such as GPS, Barometer, Accelerometer, Gyroscope, etc. and components such as motors. This drone was programmed for two modes that are manual mode and autonomous mode. This paper was published by K. L. E. Institute of Technology, Hubballi, Project reference no.:39S_BE_0564.[3]

III.METHODS AND ALGORITHMS

A. Agriculture Wonder Drone System using micro-controller 8051

The proposed system is an embedded system which will closely monitor and control the microclimatic parameters of a greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent. The system comprises of sensors, Analog to Digital Converter, microcontroller and actuators. When any of the above mentioned climatic parameters cross a safety threshold which has to be maintained to protect the crops, the sensors sense the change and the microcontroller reads this from the data at its input ports after being converted to a digital form by the ADC. The microcontroller then performs the needed actions by employing relays until the strayed-out parameter has been brought back to its optimum level. Since a microcontroller is used as the heart of the system, it makes the set-up low-cost and effective nevertheless. As the system also employs an LCD display for continuously alerting the user about the condition inside the greenhouse, the entire set-up becomes user friendly. Thus, this system eliminates the drawbacks of the existing set-ups mentioned in the previous section and is designed as an easy to maintain, flexible and low cost solution [21]. But unfortunately microcontroller has some drawbacks that can be overcome with use of ARM processor [2][4]. Limitations of ARM7 are Cost is high, Complex instruction set, Complicated to designs because number of pin is more [16].

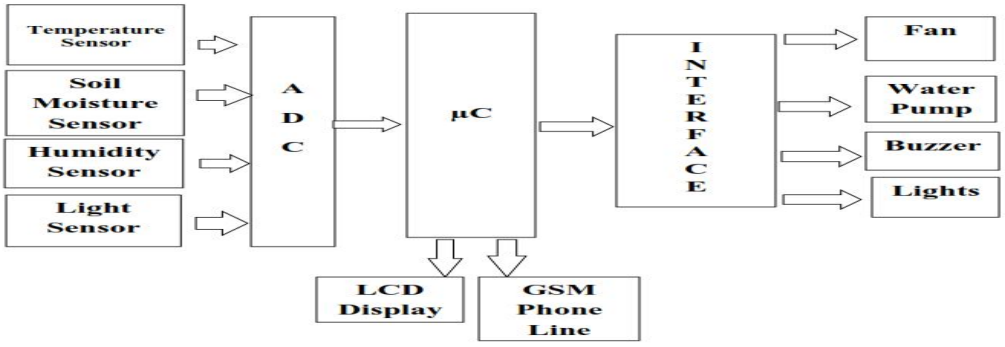

Fig. 1. Block diagram of Agriculture Wonder Drone System using micro-controller 8051

B. Agriculture Drone system using GPS

The Agriculture Wonder Drone System is designed by making use of GPS where the automatically controlled drone based on aerial pesticides sprayer mainly consisting of two parts the quad copter and spraying mechanism. Initially quad copter is assembled using necessary components such as flight controlled board (FCB), GPS, BLDC motor, ESC controller and battery, etc. Where the drone was behaved at required altitude, and then it is switch to altitude hold mode, which maintains the same altitude until it is switched back.

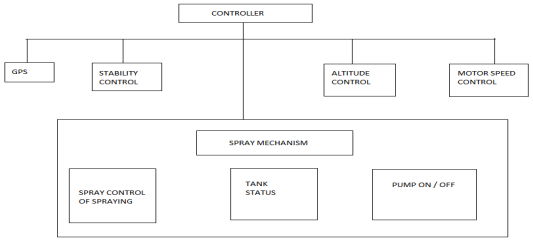

Fig. 2: Block diagram of Agriculture Wonder Drone using GPS system

The stability of drone maintain by sensors. GPS is used in only autonomous mode. According to the changes in the values of sensors the motor speed is vary. Pump used to turn ON/OFF the water pump which is used to spray. With the help of GPS system can also share the data through wireless medium [2][3][4] .

C. Agriculture wonder drone system using Atmega 328

All the limitation discussed in above systems can be overcome if the system is implemented using Atmega 328. This system is will used BLDC motors which are multiphase, normally 3 phases, so direct supply of DC power will not turn the motor ON. Electronic speed controller (4 used for the generating high frequency signals with different but controllable phases to keep the motor turning. The ESC controller is also able to source a lot of current as the motors can draw a lot of power. 30 PRM 12V DC geared motors for robotic applications are very easy to used and available in standard size. To measure acceleration accelerometer used and to measured angular velocity gyro meter is used. LiPo battery can be found in single cell of 3.7V to in a pack of over 10 cell connected in a series (37V). Where the communication with the *HMC5883L* is simple and all done are through an I2C interface. There is an on board regulator. The breakout board includes the *HMC5883L* sensor and all filtering capacitors.

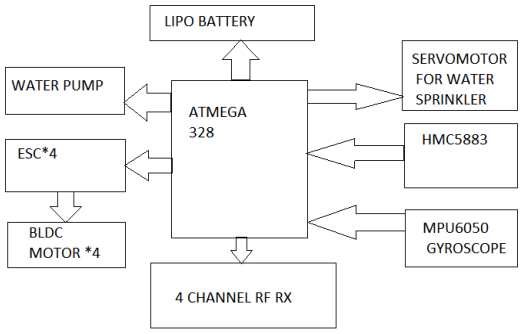

Fig. 4. System block diagram using Atmega 328

D. Agriculture Wonder Drone using ATMEGA 644PA

The Agriculture Wonder Drone system is designed by making used of Microcontroller Atmega 644PA. In this block diagram of Agriculture wonder drone accelerometer and gyrometer sensors are used for the purpose of measuring accelerations and force so the downward gravity will also be sensed. A gyro meter is used for measuring angular velocity, in other words the rotational speed around the three axes. There are different sections of transmitter and receiver. In this block diagram the transmitter section consist of signal sampling block which is used for quantization and sampling of signal. Frequency modulator is used for modulation purpose and filtering part done by band pass filter. The receiver section consisting of battery, ESC controller, motors and sprinklers. Sprinkling has two sections simultaneously remote controller and sprayer controller. The remote controller section is used to control the actuator of sprinkler. The nozzle of sprayer module was get activated by remote controller. Wherever there was a need to activate a sprayer by RF transmitter remote. Sprayer model contains two modules spraying and controller module. Pesticide was get spray and the controller section activated the nozzle of the section. Tank status also gets verified.

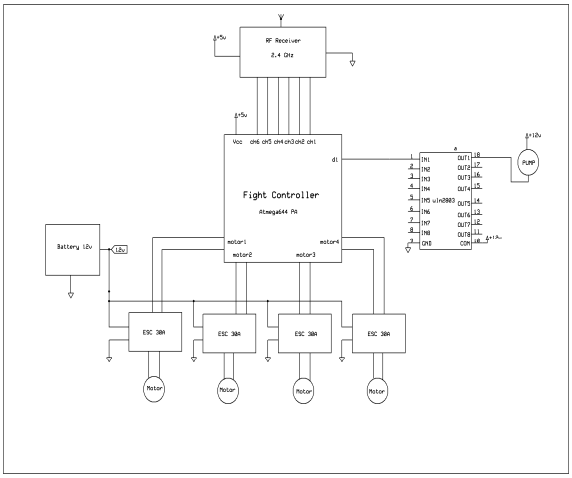

Fig. 3. Block diagram of Agriculture Wonder Drone System using Atmega 644PA.

E. Atmel 644PA

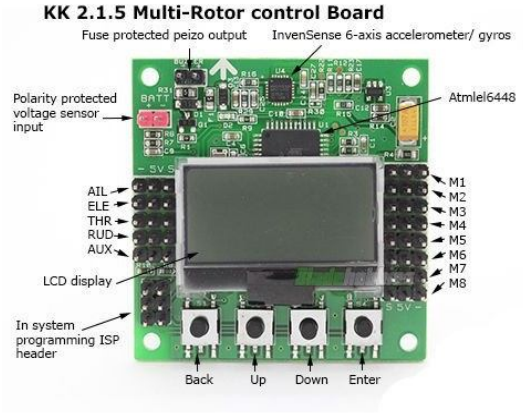

Fig 5. Atmega 644PA

It takes the signal from 6050 MPU Acc/gyro (roll pitch/yaw) then passes the signal to Atmega 644PA IC. The Atmega 644PA IC unit processes this signal according to user selected firmware and passes control signal to ESC. This signal instructs to make fine adjustment to rotor rotational speed which in turn stabilizes multi rotor craft. Hobby king 2.1.5 multi rotor control board which uses the signal from radio system (RX) and passes the signal to the Atmega 644PA/IC via aileron, elevator, throttle and radar input. Once the information has been proceed, The IC will send varying signal to ESC in which in turns adjust the rotational speed of each rotor to induce controlled flight (up, down, forward, reverse, left, right and yaw).

F. LiPo battery

Nominal voltage is the default, resting voltage of a battery pack. ... LiPo batteries are fully charged when they reach 4.2v/cell, and their minimum safe charge, as we will discuss in detail later, is 3.0v/cell. 3.7v is pretty much in the middle, and that is the nominal charge of the cell.

G. ESC controller

An electronic speed control or ESC is an electronic circuit with is used to control the speed of servo-motor, its direction and possibly also to act as a dynamic brake. ESCs are often used on motors essentially providing an electronically-generated three-phase electric power low voltage source of energy for the motor. It also allows much smoother and more precise variation of motor speed in a far more efficient manner than the mechanical type with a resistive coil and moving arm once in common use.

H. BLDC motors

Fig.6. BLDC motor

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors), or synchronous DC motors, are synchronous motors powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each phase of the motor via a closed loop controller. The controller provides pulses of current to the motor windings that control the speed and torque of the motor. The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor.

I. RF 2.4 GHz remote controller

Fig.7. RF 2.4Ghz remote control

Many embedded devices use handheld IR and RF remote controls. TVs and radios typically have Infrared (IR) remote controls. Most cars now have a radio frequency (RF) remote key fob. Wireless keyboards and mice use RF links at 27 MHz or 2.4 GHz. Instead of IR one we one also use Node MCU. Less complicated Wi-Fi module is inbuilt in node MCU [6]

IV. EXPERMENTATIONANDEXPECTEDRESULT

The Agriculture drone has the potential to improve the crops. Agriculture Drone can helps the farmers to transform the agriculture industry. Now a day's farmers use a hand pump for spraying pesticides. Human beings take large amount of time to spray the crops and they don't uniformly spray the pesticides. But by using drone we can complete the spraying work in less amount of time as compare to human. Human being charges 100/- to 200/- rupees per day for pesticides spraying, as compared to them drone takes 3 watt of power then it will charge 10/- rupees only of electricity. Drone will uniformly spray the fertilizers hence; there is no possibility of damaging crops. Drone will save the time of spraying pesticides and also it will reduces the diseases caused by fertilizer to the human body such as skin diseases as per the research of World Health Organization (WHO). Hence, drone will minimizes the efforts of farmers for agriculture purpose. While deigning the required circuitry it is very necessary to follow all the design and development steps for PCB designing [8].

V. CONCLUSION

In this manuscript different types of system useful for Agriculture wonder drone system using micro-controller 8051, Agriculture wonder drone system using Atmega 328 microcontroller and Agriculture drone system using GPS were discussed. Mainly the paper focused on selection of best compatible design for Drone system for Agriculture purpose. Some of the exiting implementation was discussed with their advantages and disadvantages. Finally it is conclude that if the system design with the use of Atmega 644PA then it will be the more efficient implementation. In line to this the experimentation and expected result also discussed for further implementation.

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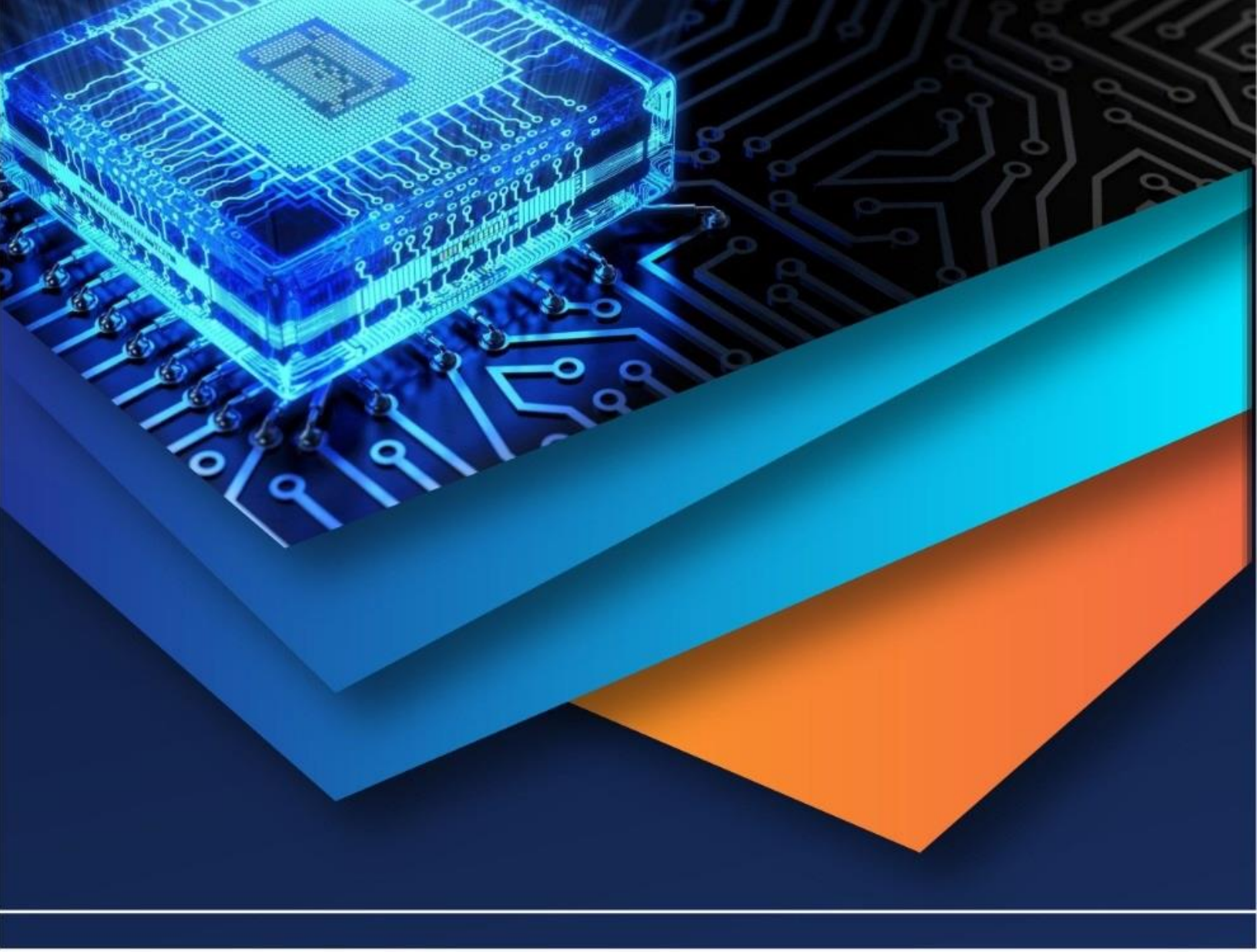

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